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Forest Insect and Disease Conditions

Prince George Forest Region 1986

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INTRODUCTION

This report summarizes the findings of Forest Insect and Disease Survey (FIDS) field studies in the Prince George Forest Region in 1986. Forest pest conditions are described with emphasis given to those capable of sudden damaging outbreaks. Most of the information was gathered through:

1. the monitoring of over 150 permanent sample stations throughout the Region;

2. the monitoring of already known or recently reported infestations and disease problems;

3. the detection of pest problems during travels through the Region;

4. annual aerial surveys during which major pest problems were mapped with reference to severity and volume losses;

5. special projects designed to gain information for research.

The report also attempts to evaluate the consequences of pest activity, providing estimates of current losses and the potential for future damage.

SUMMARY

Spruce beetle mortality declined for the fourth consecutive year to near endemic levels, with volume losses of 2 050 m^3 over 147 ha. Eastern spruce budworm lightly and moderately defoliated primarily white spruce over 94 700 ha, along the Fort Nelson and Liard rivers. Two-year-cycle spruce budworm caused mostly light and moderate defoliation of white spruce and alpine fir over 15 670 ha in the Bowron River and Slim Creek drainages. Five young natural spruce stands were found to be free of Inonotus (Polyporus) tomentosus root disease infections. Declining northern spruce engraver populations killed the tops of an estimated 500 white spruce and reattacked many of the trees reported top-killed in 1985. Spruce weevil populations declined causing light white spruce terminal mortality in the Bowron Valley and north of Prince George near Summit and Tacheeda lakes.

Mountain pine beetle mortality decreased slightly to 9 000 m^3 over 1 225 ha but was distributed more broadly throughout the southern one-third of the Region. Analyses of 40 lodgepole pine stem samples from widespread locations throughout the Region found no pinewood nematode. Fear of importation of this pest has prompted quarantines against green Canadian wood products by some European countries. Seedlings grown from Swedish lodgepole pine seeds were planted in pre-selected sites near Fort St. James, Mackenzie, Fort St. John and Fort Nelson, in a cooperative program involving Svenska Cellulose, a large Swedish forest company, the B.C. Forest Service (BCFS), Canadian Forest Products (Canfor), the University of British Columbia (UBC) and the Canadian Forestry Service (CFS). Needle infections by Lophodermella needle disease and red band needle disease in lodgepole pine at the Red Rock Seed Orchard were much reduced in 1986. Severe lodgepole pine needle cast infections were widespread between Summit Lake and Muncho Lake. A lodgepole pine dwarf mistletoe hyperparasite was common in mistletoe-infected stands north and west of Prince George. Western balsam bark beetle killed 7 180 alpine fir over 3 000 ha in increased activity centered primarily in the area of Takla Lake. Tip blight of alpine fir was prevalent for the fourth consecutive year near McLeod Lake and in wet belt stands southeast of Prince George.

Douglas-fir beetle mortality decreased for the second consecutive year to 73 trees, near Averil and Eaglet lakes.

Forest tent caterpillar defoliation of trembling aspen increased to 91 100 ha in the Peace River area with an additional 580 ha in the Salmon Valley. Large aspen tortrix defoliation of trembling aspen was patchy and widespread along the Alaska Hwy. between Fort St. John and Wonowon and near Fort Nelson and Summit Lake. Gypsy moth pheromone traps were placed in 39 provincial parks, rest areas and private campgrounds. No male moths were caught. Light and moderate defoliation of white birch by the ambermarked birch leafminer was common within a 5-km radius of Prince George.

The black army cutworm destroyed 10 000 lodgepole pine seedlings at Km 85 of the Bowron Road and caused moderate damage to white spruce seedlings at Km 10 of the Haggen Creek Road.

Drought in the summer of 1985 resulted in thinning of the foliage of trembling aspen and white birch in many areas in the southern portion of the

Region, and some top dieback southeast of Prince George.

Additional special surveys included pests of Provincial Parks, pests of young stands and pheromone trapping of clearwing moths.

The FIDS field season extended from May 26 until September 25, during which time 350 insect and 60 disease collections were made at various locations throughout the Region (Map 1).

The B.C. Forest Service provided 42 hours of fixed-wing aircraft time and 2 hours of helicopter time for aerial surveys in the 1986 season (Map 2).

APPENDICES

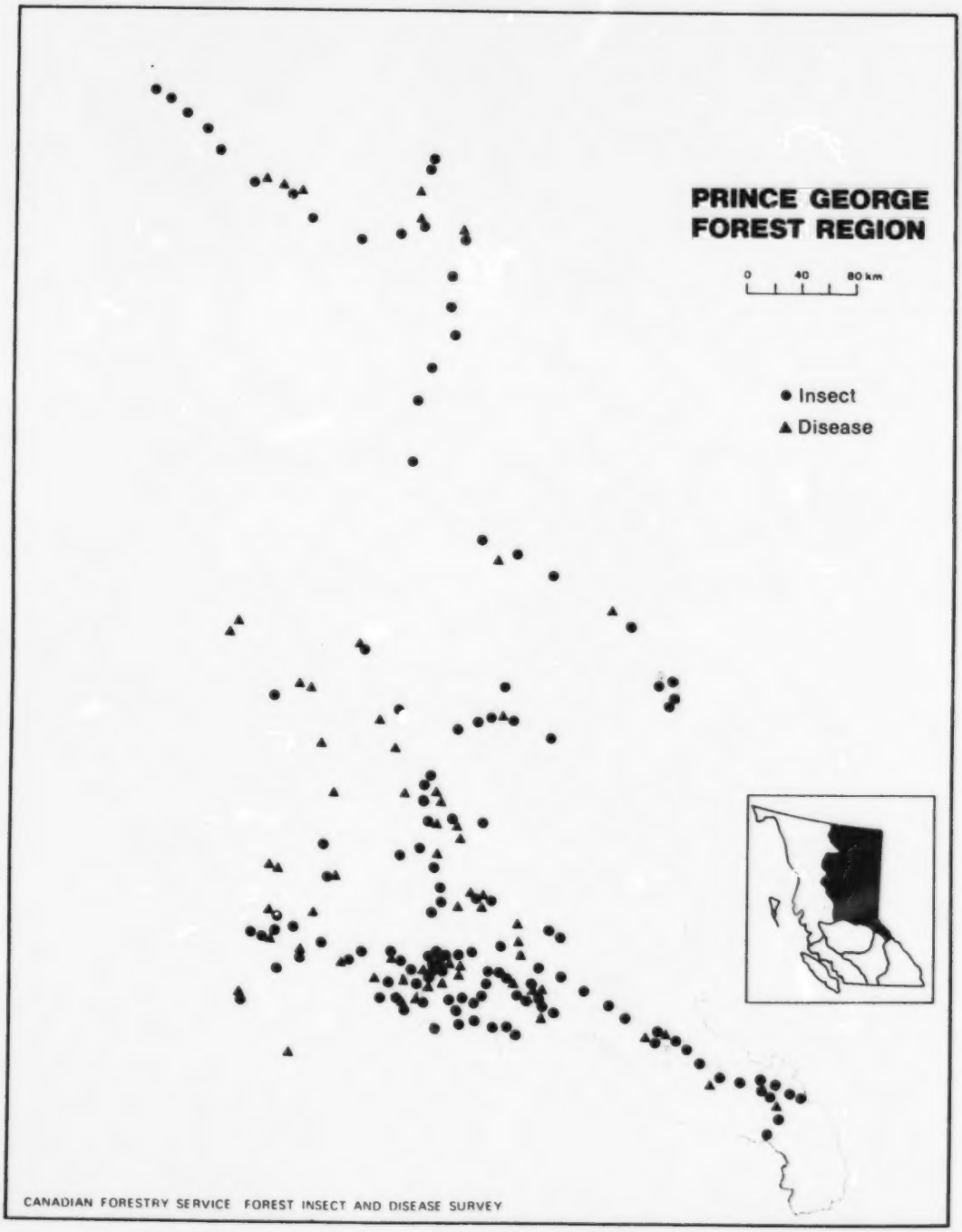
Reports summarizing pest activities or projects undertaken during the course of the year can be obtained upon request from the Pacific Forestry Centre, c/o the author or authors.

1. Prince George Mountain Pine Beetle, February 1986. R. Garbutt.

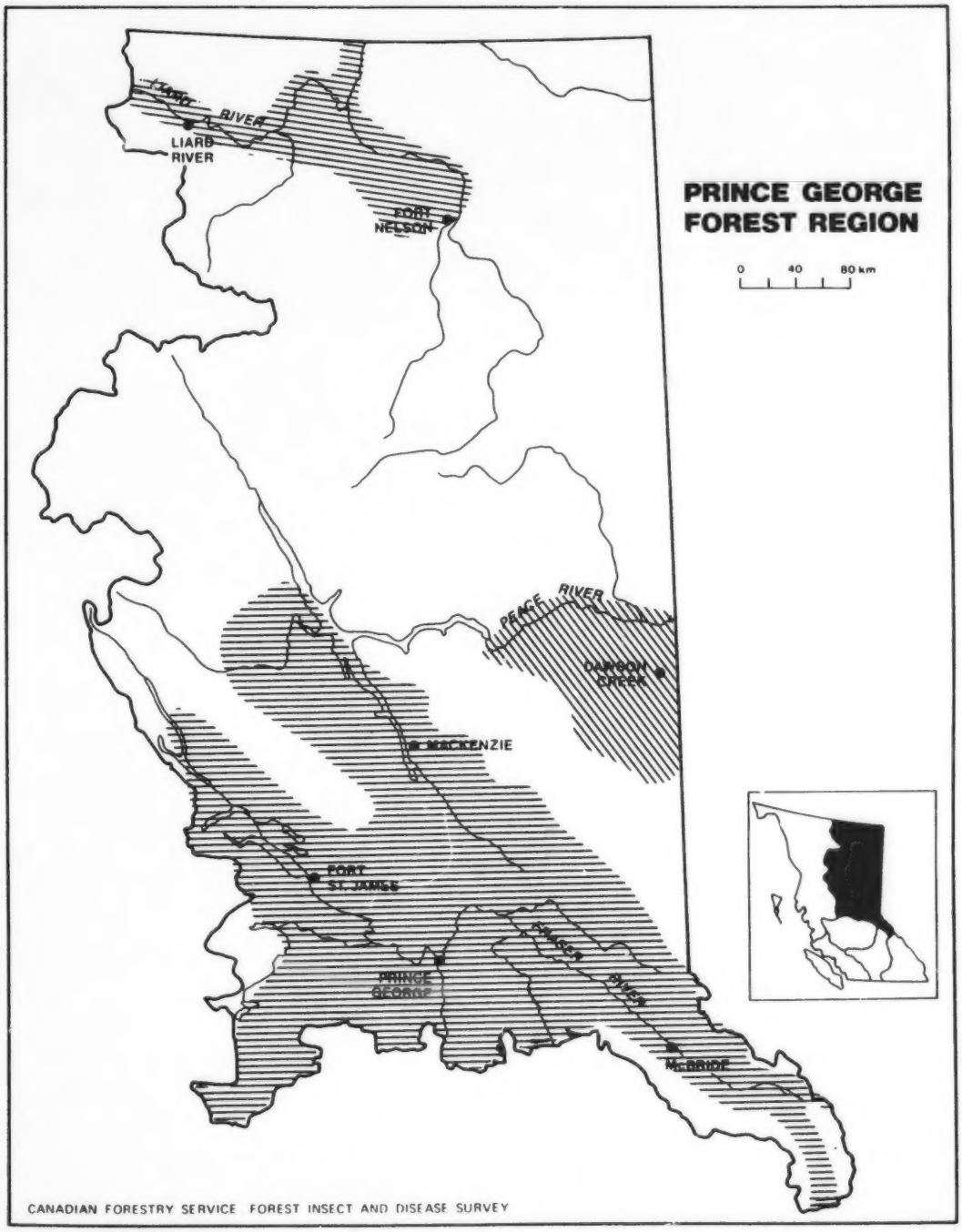
2. Special Report 'Mt. Robson Provincial Park - Mountain Pine Beetle Training Session', November 1986, R.D. Turnquist.

3. Pest Report 'Forest Tent Caterpillar in B.C. in 1986 and Forecasts for 1987', December 1986, J. Vallentgoed and R. Garbutt.

4. Pest Report 'One- and Two-year cycle Budworms in Alpine Fir - Spruce Stands in British Columbia in 1986 and Forecasts for 1987-88', December 1986, R.J. Andrews, R.D. Erickson, R.W. Garbutt, C.S. Wood.



Map 1. Locations where one or more forest insect and disease samples were collected in 1986.



Map 2. Areas covered by aerial surveys to map bark beetle and defoliator infestations, 1986.

SPRUCE PESTS

Spruce beetle, Dendroctonus rufipennis

The collapse of a major spruce beetle epidemic in the Bowron and McGregor river drainages culminated this year following four consecutive years of declines in mortality. In 1986 only 2 050 m^3 of recently killed white spruce were recorded in the Prince George Region over 147 ha (MAP 3), compared with 78 200 m^3 over 4 000 ha in 1985. Total mortality amounts to little more than endemic levels for spruce beetle and is the lowest regional mortality since 1976.

Over 95% of infested timber mapped in 1986 was located in the Upper McGregor River drainage in Jarvis, Revolution, Kitchi and Bastille creeks, all within the same infestation that has killed over 80% of the white spruce component over 6 000 ha since 1980. All other infestations were in small 1-5 tree groups scattered mostly in the Hominka River area.

In the summer of 1985, white spruce blowdown was mapped during annual aerial surveys near Narrow and Tumuch lakes, in the Everett and George creeks areas, and in the Willow River Valley over an aggregated area of over 300 ha. Very low levels of attack were found in all areas that were examined following the 1986 spruce beetle flight period and attacks are not expected to pose a threat to surrounding timber.

The explosion of beetle populations was made possible by a combination of large amounts of fresh white spruce blowdown which provided ideal habitat allowing populations to build dramatically in a single generation, and large volumes of susceptible standing white spruce which were subsequently attacked. The Bowron infestation began a year earlier than the McGregor, and peaked quickly in 1980 in a single two-year generation cycle (Table 1). When the infestations began, accesses into the infested areas were limited in the Bowron and non-existent in the Upper McGregor. The 'Sandy Road' leading to the Babette mine, beyond the River's headwaters was used to haul rock from the mine, but this was just a narrow rough track unsuitable for log hauling. By the time the McGregor infestation was recognized in 1980, cut quotas and manpower were already committed to salvaging the more accessible vast stands of attacked timber in the Bowron. The McGregor infestation peaked in 1981, but remained largely unaccessed until the winter of 1983-84, when the 'Sandy Road' was upgraded to allow for the hauling of timber. By the time summer nauling in the McGregor became possible in 1984, most of the beetle-killed timber in the upper reaches including McCulloch, Kitchi, Revolution and Bastille creeks was grey, and much of it was sap-rotted and unsalvagable. The rate of attacks was accelerated in the Bowron in 1983 and again in 1984 when successive mild winters stimulated up to 25% of the beetle population to cycle in one year instead of the normal two.

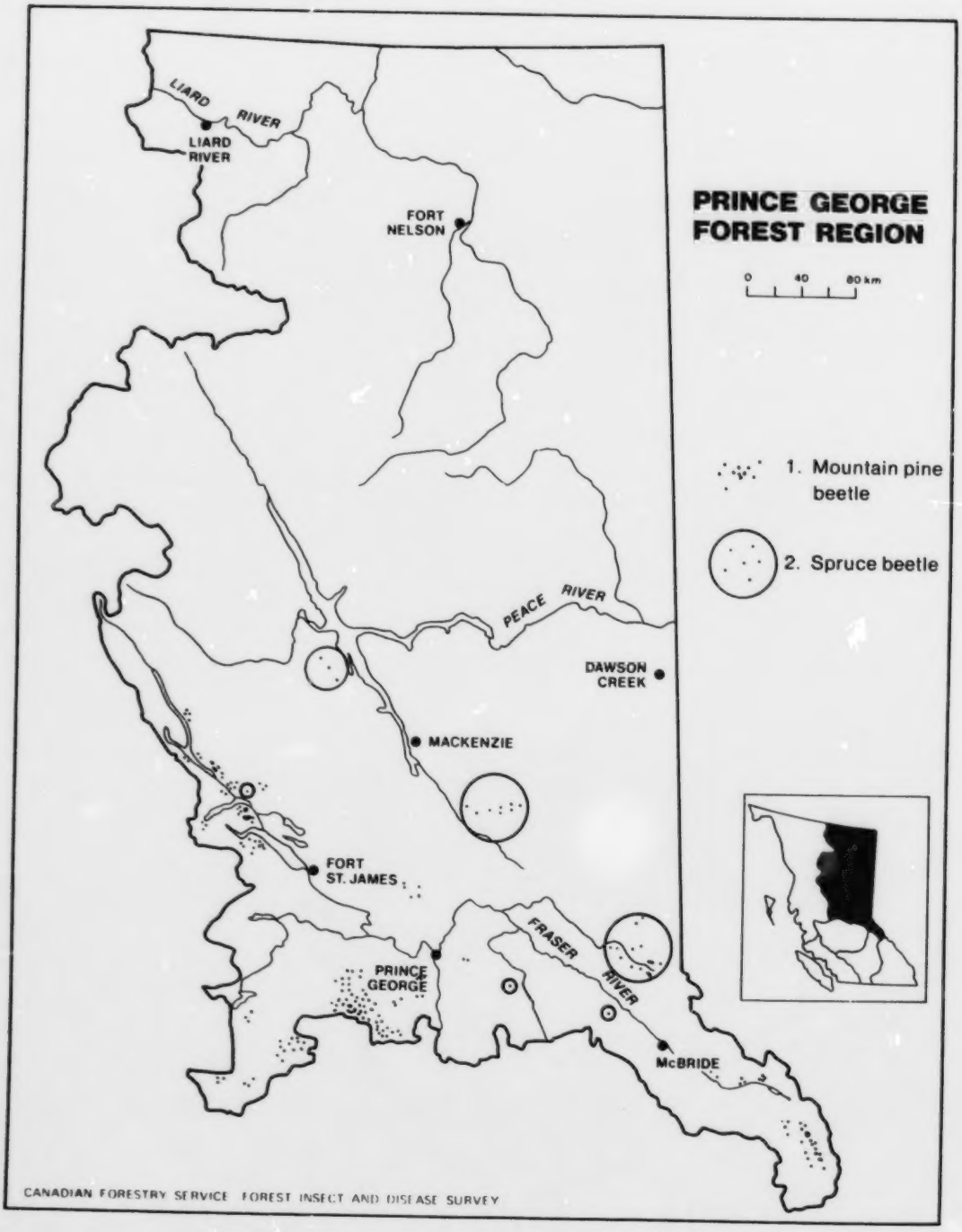
In four years more than 10 000 000 m^3 of timber were hauled from the Bowron. Infestations in the Parsnip River drainage peaked in 1981 but never approached the scale of the Bowron or McGregor. Beetle populations collapsed in both areas in 1984, and are expected to remain at low levels in 1987.

Infestation Summary

Table 1. Summary of Bowron and McGregor-Parsnip spruce beetle epidemic from 1978-1986, Prince George Region, 1986.

Year	Regional Totals area (ha)	Regional Totals vol (m^3)[1]	Bowron-Willow area (ha)	Bowron-Willow vol (m^3)	McGregor-Parsnip area (ha)	McGregor-Parsnip vol (m^3)	Remarks
1978	38 160	-	0	0	0	0	Infestations in Fort St. James and Summit Lake areas. Blowdown in upper Bowron-Willow.
1979	53 330	-	2 300	-	0	0	Blowdown in McGregor R.
1980	64 400	-	34 800	-	8 100	-	Peak of Bowron infestation.
1981	59 000	-	24 000	-	22 500	-	Peak of McGregor infestation.
1982	57 500	2 000 000	26 000	1 380 680	19 250	474 300	Slight aggregate decrease.
1983	32 980	1 400 000	16 760	554 600	14 350	792 000	High proportion severe mortality in McGregor R.
1984	25 470	525 900	9 050	216 700	14 100	194 500	Population collapse. Most infestations light.
1985	400	78 200	1 530	36 350	2 470	41 850	Small patches of light mortality in vast areas of grey.

[1] Volume losses not estimated before 1982.



Map 3. Areas of recent tree mortality detected during aerial and ground surveys, 1986.

Eastern spruce budworm, Choristoneura fumiferana

Light and moderate[1] defoliation of white spruce and some alpine fir covered 94 700 ha along the Fort Nelson and Liard rivers in the extreme northern part of the Region in 1986, a more than twofold increase in area from 1985 when trace and light defoliation were recorded. Defoliation was almost continuous along the Fort Nelson River from the Snake River to the confluence with the Liard, and north along the Liard to the Northwest Territories (NWT) border (Map 4). It was between Nelson Forks and the NWT border that the 1985 defoliation occurred. Major areas of expansion in 1986 included Kledo Creek, where moderate defoliation was seen adjacent to the Alaska Highway at Km 530, and north of Liard Hot Springs along Smith and Coal rivers where defoliation was primarily light.

Three-tree beatings in lightly defoliated stands at the Nelson River crossing along the Fort Simpson Highway, at Coal River and near Kledo Creek yielded 950, 880 and 225 larvae, respectively. Mass larval collections sent to the Great Lakes Forestry Centre in Sault Ste. Marie, Ontario were confirmed by enzyme analysis to be C. fumiferana.

[1]Aerial survey defoliation classes:
Light - Defoliation barely visible from the air; some branch and upper crown defoliation. **Moderate** - Pronounced discoloration; noticeably thin foliage. Top third of many trees severely defoliated; some completely stripped. **Severe** - Bare branch tips and completely defoliated tops. Most trees more 50% defoliated.

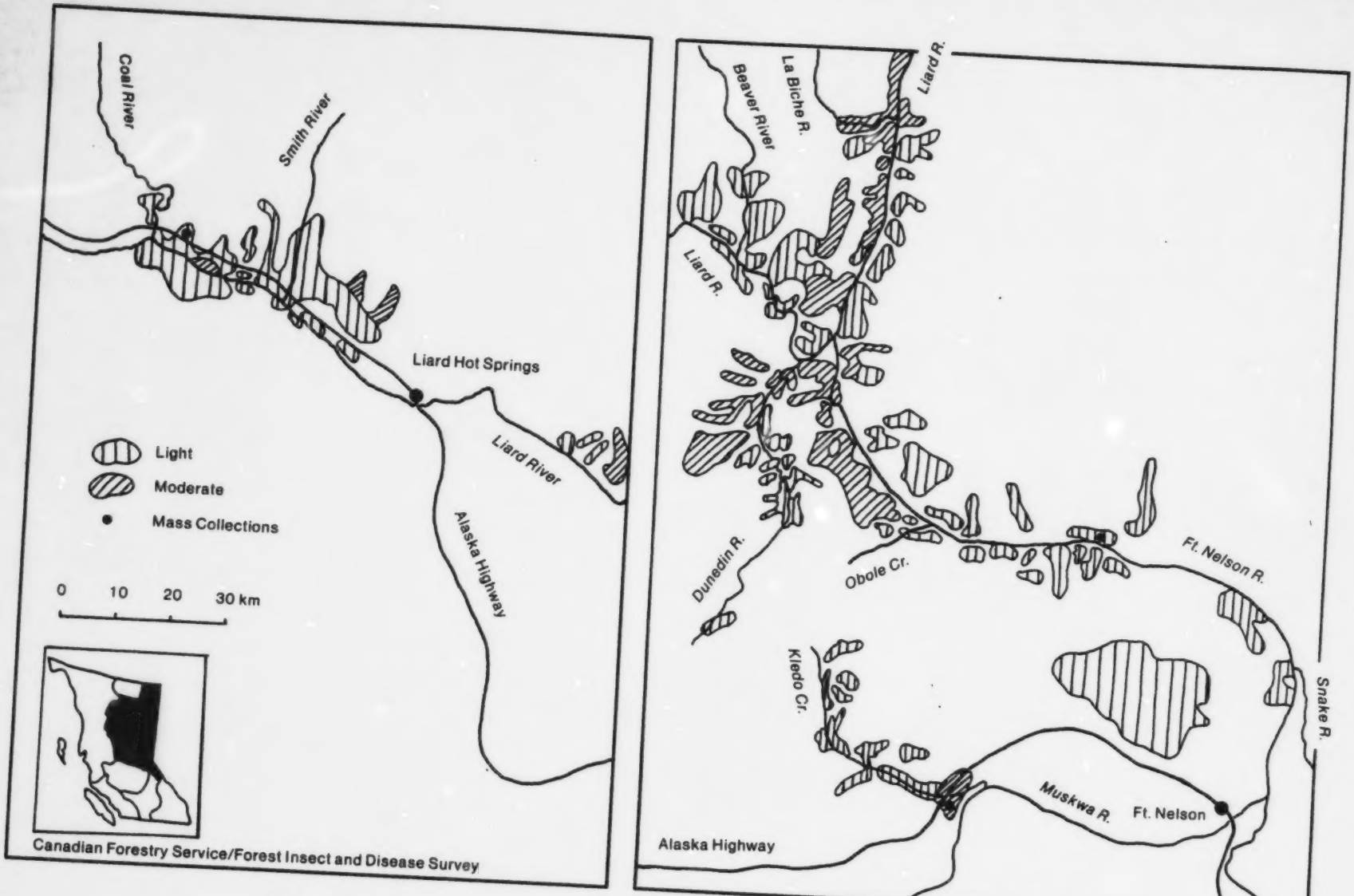
Four sets of pheromone-baited traps were set out in the Region in 1986. Results are summarized in Table 2.

Table 2. Number of adult male Choristoneura spp. caught in pheromone-baited traps, Prince George Region, 1986.

Location	Trap Type	No. of traps	Pheromone	Avg. no. moths/trap	Species
Tudyah L.	multipher	4[2]	A[3]	22.6	C. orae
		5	B	16.8	C. f.o.b.[4]
Chetwynd	multipher	5	A	4.6	C. orae
		5	B	70.2	C. f.o.b.
Kledo Cr.	sticky	5	A	19.6	C. orae
		5	B	132	C. fumiferana[5]
Liard Hot Springs	sticky	5	A	16.2	C. orae
		5	B	72	C. fumiferana[5]

[2]One trap not recovered [3]A - aldehyde formulation; B - acetate formulation
[4]C. fumiferana, C. occidentalis and C. biennis are all attracted to the same pheromone.
[5]Species confirmed by enzyme analysis.

The historical duration of these infestations suggests that populations will remain high and defoliation will recur in 1987.



Map 4. Areas of white spruce and alpine fir defoliated by eastern spruce budworm, Prince George Region, 1986.

Two-year-cycle spruce budworm, Choristoneura biennis

Budworms defoliated white spruce and alpine fir over 15 670 ha in 1986, in the Bowron River and Slim Creek drainages, including 8 360 ha of light defoliation, 7 100 ha of moderate and 220 ha of severe. In 1985 early instar larvae caused light defoliation over 580 ha but this is the first significant defoliation by mature larvae in the Region since 1982 when stands were lightly defoliated along the upper Willow River.

On the east side of the Bowron River, 6 240 ha of light and moderate defoliation were mapped during August aerial surveys in Spruce, Centennial, Everett, Slim and Grizzly Bear creeks, and on mountain slopes surrounding Tumuch and Slim lakes (Map 5). Severe defoliation over 220 ha was seen on southeast-facing hills above Tumuch Lake. On the west side of the Bowron, 5 360 ha were lightly defoliated between Fly and Wendle creeks. Farther south, 1 200 ha of moderate defoliation in the upper Willow River, Paput and Rond creeks were continuous with an infestation in the Cariboo Region. On the south side of Stony Lake mature timber was moderately defoliated over 1 450 ha, and on the north side of the Lake, four small patches of moderate defoliation covered 250 ha.

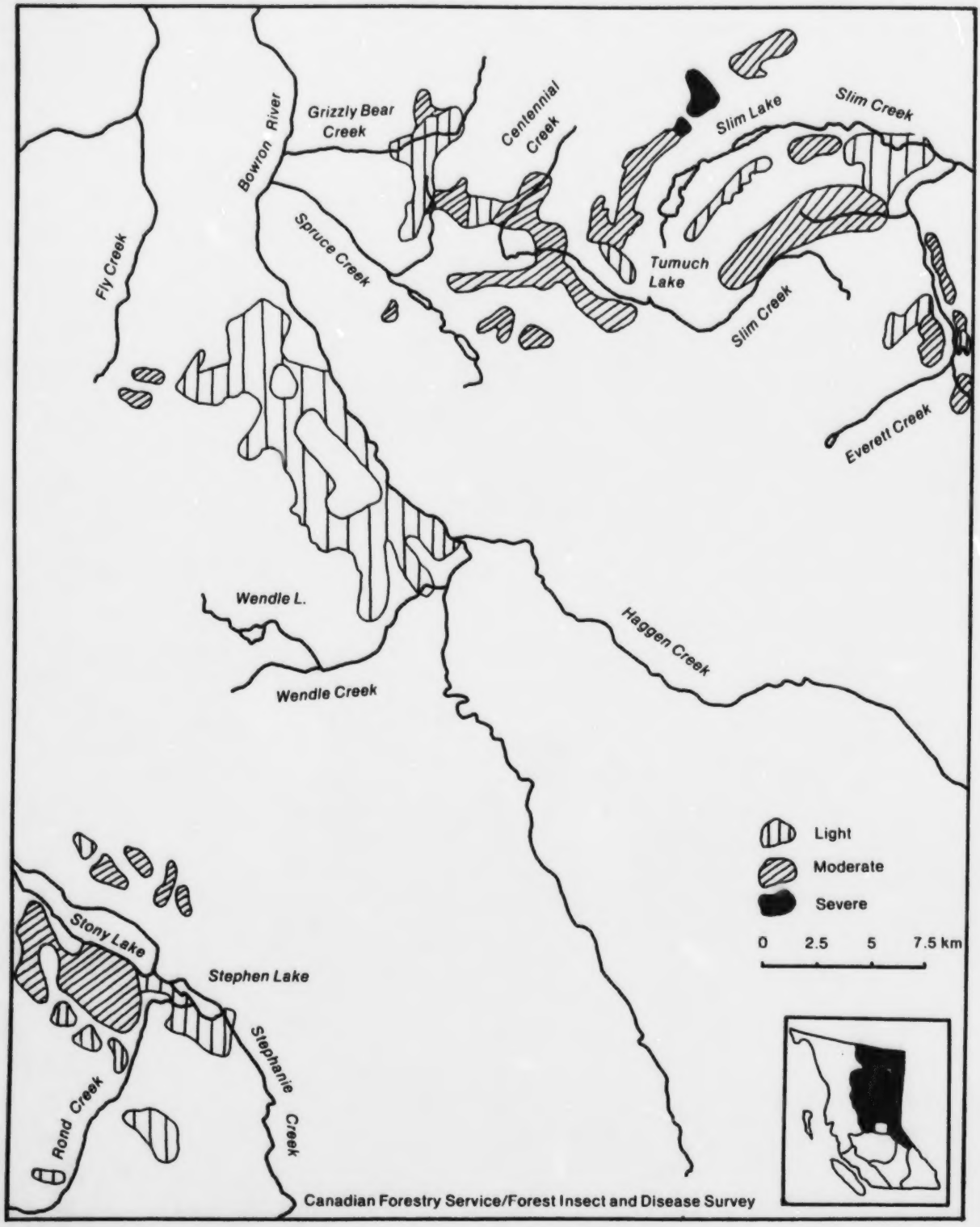
Larval samples from the infestation adjacent to the Bowron Coal Road were lightly (4.8%) parasitized by Glypta sp., too low to significantly affect budworm populations. A soldier beetle (Podabrus sp.) was observed feeding on a C. biennis larva in Everett Creek, but this insect is not known to be a common budworm predator.

Egg samples from six locations indicated an increase in populations in 1987 which will cause severe bud damage in five areas and light damage in one (Table 3).

Table 3. Numbers of C. biennis egg masses and predicted 1987 bud damage from six locations, Prince George Forest Region, 1986.

Location	1986 defoliation	egg masses/10 m^2 foliage 1984	1986	Predicted[1] 1987 bud damage
Stephanie Creek	trace	6	19	light
Stony Lake	moderate	19	194	severe
Bowron Coal Rd.	light	17	331	severe
Tumuch Lake	moderate	22	538	severe
Everett Creek	moderate	26	244	severe
West Everett Creek	moderate	19	224	severe

[1] 1-50 eggs, light; 51-150, moderate; 151+, severe.



Map 5. Areas where white spruce and alpine fir were defoliated by the two-year-cycle spruce budworm, Prince George Region, 1986

Root and butt rot of spruce, Inonotus (Polyporus) tomentosus

Five young naturally regenerated stands in which white spruce was a major component were examined this year for I. tomentosus (refer to Pests of Young Stands), but no infections were found.

In 1984-85 a total of 30 mature white spruce stands were examined for root rot infections. The disease was confirmed in at least one-third of the trees examined in each of 16 stands west of Prince George. In more intensive sampling of 14 stands located north and east of Prince George, a minimum of two roots from each of 209 trees were examined. An average of 71% of these trees were infected, with a range of 40-100% in individual stands. Of the infected trees, 58% contained incipient rot in the form of a pink stain which was confirmed in culture at PFC to be I. tomentosus. In the remaining 42% the decay was well advanced with at least some degrade of the woody tissue. With such high levels of infection in mature stands, two questions were suggested:

1. At what age does the infection enter the stands?
2. How quickly does the fungus develop in the roots?

In the Prince Rupert Region in eight surveyed 20-year-old and younger white spruce plantations (Unger and Humphreys 1984), 3.1% of the trees were either infected or had been killed by the disease. In these plantations the young tree roots quickly came into contact with residual roots from the previous stand, still harboring the fungus which had survived as a saprophyte. In the Prince George Region almost all sapling-sized spruce have regenerated naturally, and more slowly, so the chances of root contact with the previous crop has been greatly reduced. Significant infection levels have been found in 40-60-year-old spruce stands in Jerry and Naver creeks and in the Beaver Forest (Merler 1984), and recently in a 40-year-old stand near Averil Lake (3 of 6 examined trees were infected). Preliminary natural young stand examinations found no I. tomentosus infections but many more young stands need to be examined, particularly those recently planted which, in the next few years, will come into contact with the disease as their roots expand.

Surveys for I. tomentosus in 1987 will be expanded to include young lodgepole pine as well as white spruce plantations.

Northern spruce engraver, Ips perturbatus

Primary attacks by this normally secondary beetle occurred in white spruce for the third consecutive year but combined top-kill and full-tree mortality declined, particularly in the Torpy River Valley to approximately 800 trees from the over 4 000 recorded in 1985. Much of the damage seen from the air this year was along adjacent Otter and Captain creeks, where a total of 200 red tops from May 1986 attacks were mapped in 6 separate locations.

In the Torpy River area less than 50 red tops were mapped in 1986 compared with more than 3 000 in 1985. The drop in counts was due to a decline in populations and the beetles habit of reattacking farther down on the same tree. Current attacks often spanned less than 3 m of the bole and discoloration of the few affectecd branches was not clearly visible from the air. The total number of 1986 attacks in this area was estimated at close to 500. Scattered small infestation centres including from 1 to 20 trees were

also seen in the McGregor Valley and along Herrick Creek. Near Stephanie Creek, south of Stony Lake, ground surveys located between 75 and 100 trees that had been attacked in the previous two years, but examinations of the boles of five of the killed trees revealed only dead parent adults. No recent attacks were seen.

During ground examinations in the Torpy River in June, only one of three previously attacked white spruce contained current I. perturbatus populations. One of the trees had been felled the previous year and was heavily attacked by the secondary engraver beetle I. latidens, but after one year on the ground the tree was no longer attractive to I. perturbatus. Three more top-killed trees were felled and examined in September. All of these had been initially attacked in 1985 but only one had been reattacked in 1986. Bolts from these trees will be used to study the frequency of internal parasites by counting the number of parasite exit holes in the beetle exoskeletons.

In 1985, duff samples were collected from the base of infested trees to try to determine the overwintering habit of the adult beetles. These samples overwintered in cold storage, but in the spring all that emerged were 10 ambrosia beetles and 4 weevils. Further samples were collected in 1986 and emergence will be observed in the spring of 1987.

Because it is essentially a secondary attacker, the number of I. perturbatus attacks is expected to decline further in 1987.

Spruce weevil, Pissodes strobi

Spruce weevil populations remained low in young white spruce stands in the Region. In a spaced stand adjacent to Hwy. 16E near Hungary Creek, where 20% of the leaders of young white spruce were infested in 1985, only 5% of the trees were attacked in 1986. No evidence of current attack was seen in roadside regeneration farther east along Hwy. 16 where attacks were common in 1985. At Summit Lake, however, 10% of the roadside regeneration was attacked for 2 km along the old highway, and 2 km north of Anzac Camp, 15% of the young stand had been attacked (3% current, 12% previous attack). Three samples of infested spruce leaders from Anzac and one from near Purden Lake were found to contain Lonchaea sp. larvae, a common predator of P. strobi. This predator coupled with two successive harsh winters may have combined to reduce spruce weevil populations. The unusually mild 1986-87 winter will enhance survival of the overwintering population, particularly larvae and pupae which have remained in the leaders, and attacks may increase in 1987.

Spruce needle and cone rusts, Chrysomyxa spp.

A spruce needle rust, C. weirii, very lightly infected lower crown needles of semi-mature white spruce near Averil Lake and at Km 59 of the Bowron Forest Road. C. ledicola infected 5% of the needles on all understory spruce within a 5-ha area beside the McKale River, near McBride. Spruce cone rust, C. pirolata, infected 3% of white spruce cones sampled from the Sinkut Lookout Road and 10% of the cones from a sample taken at Km 75 of the Bowron Road.

PINE PESTS

Mountain pine beetle, Dendroctonus ponderosae

Lodgepole pine mortality due to attacks by the mountain pine beetle decreased slightly to 9 000 m^3 over 1 225 ha in 1986 compared with 11 760 m^3 over 630 ha in 1985 (Map 3).

Significant local increases in the form of numerous small infested pockets were seen north of Fort St. James near the Tachie and Middle rivers, between Fraser and Francois lakes, southwest of Prince George from Bobtail Lake south throughout the Blackwater area, and west of Tagai Lake. Declines in volume resulted from several factors: intensive single tree disposal in the Cariboo regional border areas from the Fraser River west to Euchiniko Lake, and in the Mt. Robson Provincial Park area; unusually cold early winter temperatures in 1984 and 1985 which killed most of the brood; and intensive salvage logging and host depletion in a long-standing infestation near Bulldog Creek on the east side of Canoe Arm.

Vanderhoof Forest District

Red trees near the Cariboo regional border south of Vanderhoof numbered less than 100 in 1986, compared with approximately 5 000 in 1985. The dramatic decline was attributed to the extreme cold of early November 1984 which killed more than 90% of the overwintering larvae. Even more severe early winter cold in 1985 killed most of the surviving brood, and concurrent single tree disposal operations ensured minimal survival. During the disposal, however, crews found many living Scolytid larvae in the stumps and roots, some as deep as 40 cm below the duff layer. Some of the larvae were readily identified as the lodgepole pine beetle, Dendroctonus murrayanae. Subsequent examination of a second more prevalent species at the Pacific Forestry Centre (PFC) Insectary identified them as Hylurgops rugipennis. Both of these beetles are secondary agents of attack and were attracted by signals of stress from the trees following attacks by the mountain pine beetle. They were saved from the effects of extreme cold by the insulating layers of snow, duff and soil. Neither insect poses a threat to healthy standing timber. Overwintering brood assessments made in the same general area near Suscha Creek in the spring of 1986 found no surviving mountain pine beetle in standing red trees excluded from the cut-and-burn program.

In other areas within the District populations were less affected by cold. Scattered new pockets of recent mortality totalling about 300 trees were mapped by aerial surveys in areas just north of Vanderhoof, between Fraser and Francois lakes and just west of Bobtail Lake. Subsequent B.C. Forest Service probes found that 65% of the mortality resulted from a combination of engraver beetle (Ips spp.) attacks, porcupine feeding, dwarf mistletoe and environmental damage.

During the August flight period, beetles attacked only 8% of the trees in pheromone-baited blocks in the Suscha/Tsacha area, further indicating reduced populations in these areas. Current to red-attack ratios in the Fraser-Francois and Bobtail-Grizzley areas were 1:1 and 1:3, respectively. Single tree disposal projects were mounted again this year to minimize the threat of expansion in these areas.

Fort St. James Forest District

Mortality more than doubled to 5 700 trees over 788 ha in 1986. For the fourth consecutive year, recent mortality was mapped during August aerial surveys in Tree Farm Licence (TFL) 42 near the Tachie River. Approximately 5 000 trees were killed in a single 100-ha infestation, and an additional 270 red trees were seen in 20 spot infestations in adjacent timber. Attacks were also scattered along the east side of the Middle River and the southeast shore of Takla Lake, but were particularly concentrated on Bill Martin Ridge, where over 200 red trees were seen in 10 separate locations. Additional small patches of mortality containing from 1 to 10 trees occurred along Inzana Lake, and near Starret Lake and Camsell Creek.

On June 3 overwintering brood assessments were made in the Camsell Creek area. Two 30-cm^2 bark samples from each of 20 1985-attacked trees yielded an 'R' value (ratio of living brood to entrance holes) of 5.1:1, indicating a strongly increasing population. Most of the brood was in 2nd and 3rd instar, slightly behind schedule for normal development. Followup B.C. Forest Service probes in fall in the same area and near Bill Martin Ridge confirmed the early analysis, finding a 2.5:1 ratio of current to red-attacked trees. Winter logging plans were adjusted to remove infested timber near Camsell Creek and along the Tachie River, and cut-and-burn was employed this fall to control the outbreaks along the Middle River and Bill Martin Ridge.

Prince George West Forest District

More than 2 000 red trees were seen in 1986 from a line between Baldy Hughes and Bobtail Lake, south as far as the Blackwater River, and from the Fraser River west to the Vanderhoof District boundary. All infestations were small, most averaging between 1 and 5 trees with the greatest concentration of attacks from Tagai Lake west to Holman Mt., and north to Bobtail Lake. Six small patches totalling 20 trees were also seen northwest of Prince George near Great Beaver Lake.

Two successive cool springs retarded normal larval development within the mountain pine beetle population with the result that attacks occurred late in the summer and into September. Most of the beetles overwintered in the galleries and laid their eggs in spring. Throughout the infested area, red pines that were attacked in 1985 and examined during fall probes, contained larvae, pupae and callow adults that will fly in the late spring and summer of 1987. The only successful current attacks were seen in pheromone-baited trees located south of Barton Lake along the 'Extension' road.

Some of the red trees, particularly on the east side of Bobtail Mt., contained only Ips sp. as primary attackers, a trend reflected in the Nazko area in the Cariboo Region where thousands of lodgepole pine were killed by Ips pini.

Cut-and-burn crews have been hired to dispose of most of the infested trees through the winter.

McBride Forest District

The area of infested timber along Canoe Arm doubled to 300 ha in 1986,

but within these areas red tree counts declined to 900 from nearly 5 000 in 1985. As in previous years, mortality was concentrated in the Bulldog Creek area (400 trees), but has declined significantly due to salvage logging and host depletion. South of Hugh Allen Creek, scattered pockets contained more than 200 trees and three infestations containing a total of 55 trees were mapped just northwest of Mt. Thompson, near the head of Canoe Arm. All other infestations south of Valemount occurred as scattered small groups of trees along the east and west side of Canoe Arm and along the west side of Mt. Thompson, south to Albreda.

Patches of mortality were seen for the second year just west of the Mt. Robson Provincial Park boundary near Swiftcurrent Creek (30 trees), and inside the Park on Shale Hill (30 trees), despite the disposal of more than 300 infested trees during the winter of 1985/86. These infestations are of particular concern due to the risk of populations spreading eastward through the relatively low elevation Yellowhead Pass into adjacent Jasper National Park and Alberta forest reserves, and westward into B.C.

To familiarize Park staff with recognition and analysis of mountain pine beetle attacks, a joint FIDS-B.C. Forest Service-sponsored training session was held within Mt. Robson Park in November. The week-long program also served to locate and evaluate 16 separate sites within the Park where red lodgepole and western white pines were mapped during earlier aerial surveys. Tree mortality at 15 of the sites was found to have been caused by a combination of factors such as porcupine feeding, attacks by the secondary lodgepole pine beetle, and white pine blister rust. Only Shale Hill, 8 km east of the Mt. Robson viewpoint contained an active mountain pine beetle population. An intensive survey of the area found 17 red and 14 current attacks. An additional 12 partial attacks had all been pitched out. Almost all current attacks were in or adjacent to pheromone-baited trees. Overall brood production was low and in 5 of the 14 trees, no brood was found. Progeny development in the remaining 9 trees was retarded with 20% still in the egg stage and the rest equally divided between first and second instar larvae. All red- and current-attacked trees will be disposed of early in 1987.

Just west of the Park boundary at Swiftcurrent Creek, 132 trees (47 red and 85 current) were disposed of in October 1986. Both of these areas will be pheromone-baited again in 1987.

The only increasing populations of mountain pine beetle within the Prince George Region occurred within the Fort St. James District. The greatest hazard remains in the long-standing infestation near the Tachie River which, until this year, was unaccessed. Increased mortality is expected in the next few years and particular attention will be paid to this area during overwintering brood assessments in the spring of 1987. Assessments are also planned for the high-hazard areas in the Prince George West District and to a lesser extent the Vanderhoof District where increased attacks could result from maturing one- and one-half-year cycle broods. This year's unusually mild winter will maximize brood survival and any currently attacked trees left standing will house a major threat to surrounding timber.

Pinewood nematode, Bursaphelenchus xylophilus

In the Prince George Region in 1986, 40 wood samples and 8 Monochamus sp. adult were collected and analyzed for the presence of B. xylophilus (MAP 6), but none was found. This is the third consecutive year that the nematode has been the object of an extensive search in a nation-wide survey to establish the following:

1. whether B. xylophilus is present in the phloem and resin ducts of conifers, particularly lodgepole pine.

2. whether, if present, it poses any threat to the health of the tree.

European countries, particularly in Scandinavia, have threatened an embargo of green Canadian wood products unless extensive sampling can prove that the North American nematode will not cause an epidemic in lodgepole and Scots pines such as it did in Japanese pine in Japan.

An additional 154 samples were submitted from the remainder of the Province, and 8 of these, primarily in the Prince Rupert Region contained living B. xylophilus. There is as yet no evidence, however, to suggest that the nematode is a current or potential pest of lodgepole or European pines.

Joint Canada-Sweden lodgepole pine trial

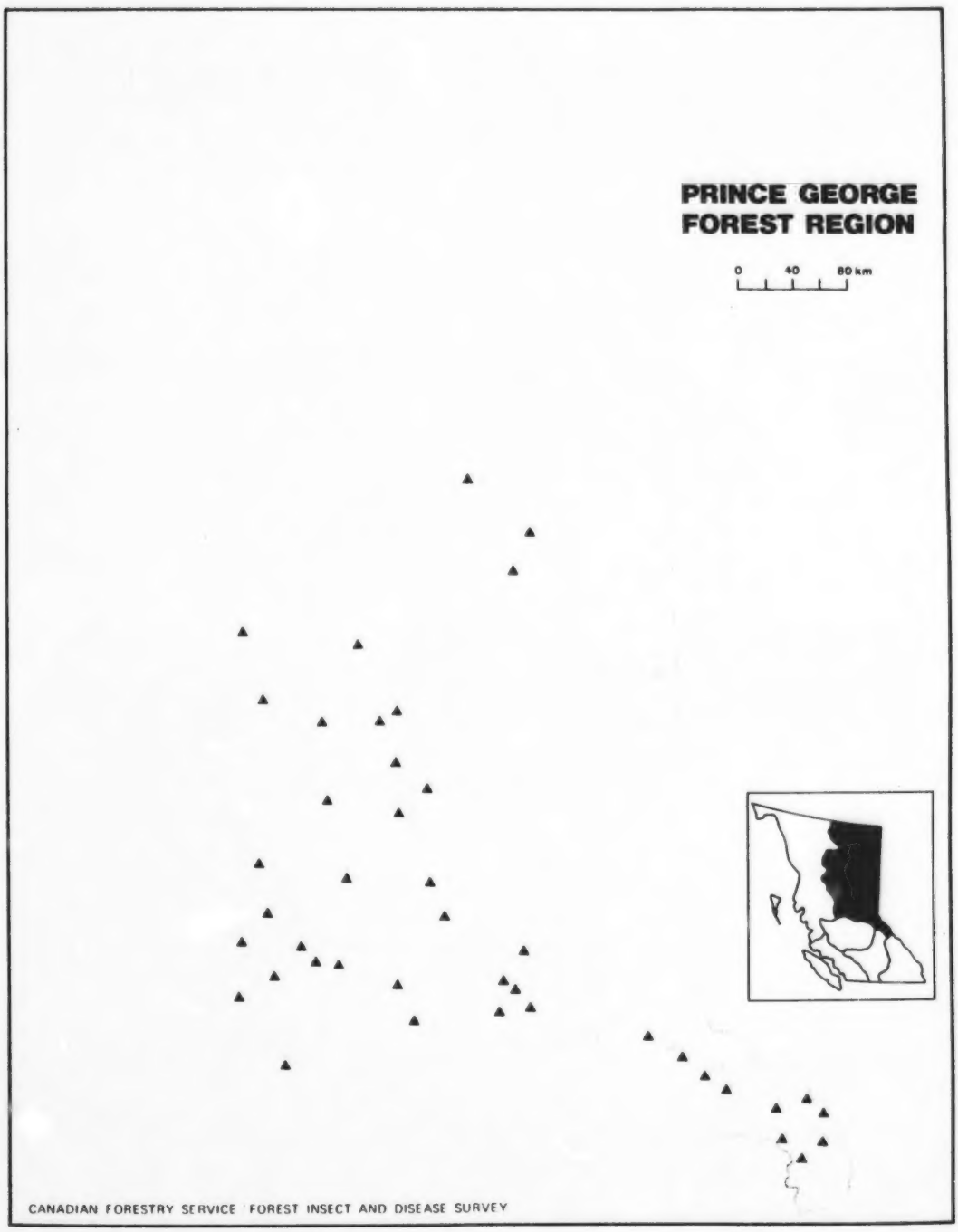
In 1986, five special sites newly planted with lodgepole and Scots pines were surveyed for actual and potential insect and disease problems. The sites, located at Fort Fraser, Mackenzie, Fort St. John, Fort Nelson and Whitehorse (Yukon) were selected in 1985 after a number of candidate sites were surveyed by FIDS and foresters from Svenska Cellulose, BCFS and UBC. The seedlings had been grown at the Balco Nursery near Kamloops from seed produced in the Svenska Cellulose seed orchard. These orchard trees had been grown in Sweden from seed gathered in B.C. from provenances similar to the newly planted sites. The project had first been suggested in 1984 as a means of testing the disease resistance of lodgpeole pine one generation removed from its native habitat and also to test the resistance of Scots pine to native pathogens. A minor component of Siberian larch and Norway spruce was also planted in all of the sites.

The seedlings were too young in 1986 to exhibit any symptoms and will be for some years. Some of the potential diseases include two stem rusts (Cronartium coleosporioides and C. comandrae), western gall rust (Endocronartium harknessii), lodgepole pine dwarf mistletoe (Arceuthobium americanum) and various needle blights and casts.

FIDS will continue to survey and evaluate pest conditions on the five sites in the coming years.

Lodgepole pine needle casts, Lophodermella spp.

Severe infections by Lophodermella sp. infected 60% of the 1985 and older needles in the upper one-third of the crowns of 50% of the lodgepole pine in scattered centres on both sides of the Alaska Highway from Muncho Lake to 20 km east of Summit Lake. The aggregated infected area covered more than



Map 6. Locations where pinewood nematode collections were made, Prince George.

1 000 ha between 1 000 and 1 200 meters in elevation. The most severe infections occurred just east of Summit Lake where, in five small patches of from one- to two-ha in size, many trees had suffered top dieback and 10% had been killed. Lophodermella concolor infected 10% of the needles on 100% of the roadside regeneration for 2 km, 3 km south of Manson Creek. Hendersonia pinicola, a fungus which hyperparasitizes L. concolor, was found on some infected needles. L. montivaga infected 5% of the needles on 25% of the lodgepole pine regeneration near the Svenska Cellulose experimental plot at Km 14 of the Teardrop Road east of Fort St. James.

Red band needle disease, Scirrhia (Dothistroma) pini

Infections of year-old and older lodgepole pine needles by this disease were generally light but widespread through the southern half of the Region. The most severe infections were found along the Manson Creek road near Km 124, where 25% of the 1985 needles were infected on 100% of the pole-sized trees. Most of the pre-1985 needles had been cast, leaving the most recent foliage as 'lions' tails' near the ends of the branches. For 5 km along the Parsnip Lookout road, starting 10 km south of Hwy. 97 north, 10% of the older foliage was infected on 100% of the trees. In a young lodgepole pine stand at Km 2 of the Shesta Lake road, 5% of the older lower crown needles on 90% of the trees were infected, and farther west, another plantation near Barton Lake was very lightly infected, losing 5% of the needles on 5% of the trees. The family provenance plantation at the Red Rock Seed Orchard which for the past two years has been severely infected, was almost free of infection in 1986.

Lodgepole pine dwarf mistletoe hyperparasite, Colletotrichum gloeosporioides

Collections of this fungal parasite of lodgepole pine dwarf mistletoe, Arceuthobium americanum, were made in five lodgepole pine stands in the Blackwater and Bobtail areas southwest of Prince George and near Bear Lake, north of Prince George. Examinations of mistletoe-infected stands in the Valemount area were negative for the hyperparasite. This fungus infects and kills the aerial shoot portion of the dwarf mistletoe plant. It causes no damage, however, to the endophytic or root system of the infected mistletoe plant, so control is affected by limiting the plants reproductive capability rather than killing it. No collections were made of two other shoot hyperparasites, Wallrothiella arceuthobii or Cylindrocarpon gillii, or any of the 18 species of canker fungi which attack the endophytic portion of the dwarf mistletoe plant.

Additional surveys are planned in 1987 to further the known distribution of C. gloeosporioides and other hyperparsites of lodgepole pine dwarf mistletoe.

Warren's root collar weevil, Hylobius warreni

Young lodgepole pine mortality was found in small pockets of from 2 to 5 trees in roadside regeneration along the east side of Canoe Arm, and in young stands at Barton and Ogston lakes. Such numbers represent endemic populations and pose little threat to the stands.

White pine blister rust, Cronartium ribicola

Aerial surveys in August identified 45 western white pine along the eastern shore of Canoe Arm, south of Ptarmigan Creek, that were recently killed by blister rust. An additional few (5-10) trees in the Robson Corridor were killed by infections. Red trees were normally seen in small groups of five or less. Mortality caused by the disease can easily be mistaken for mountain pine beetle from the air, but can be recognized because only the white pine component of the stands is affected, and often only the top portion of the tree is killed.

Blister rust is a chronic problem in white pine stands and mortality similar to this year's will continue in the future.

ALPINE FIR PESTS

Western balsam bark beetle complex, Dryocoetes confusus
Ceratocystis dryocoetidis

Scattered recent mortality of alpine fir caused by the balsam bark beetle and its associated fungus was mapped during annual aerial surveys in various areas in the southern half of the Region. A total of 7 180 trees were killed in 160 separate infestations over an area of 3 000 ha, compared with 5 240 trees over 4 600 ha in 1985. The greatest concentration of red trees was seen in the Takla Mountains between the North and Northwest arms of Takla Lake, where 3 170 were killed over 700 ha in 12 locations. Most of the remaining mortality occurred: along the Manson River just south of the Manson lakes, near Stuart Lake, near Mackenzie, south of Vanderhoof and in high elevation stands in the Bowron Valley.

Balsam bark beetle is a chronic problem and mortality is expected to continue in the coming years.

A tip blight of alpine fir, Delphinella sp.

For the fourth consecutive year, tip blight killed the growing tips of alpine fir in widespread stands in the southern part of the Region. The most northerly and severe infections were seen at Honeymoon Creek on the west side of Pine Pass, where 60% of the tips were killed on 100% of the trees. Branch tip infections continued but diminished in severity south almost to Bear Lake. At McLeod and Tacheeda lakes, 5% of the tips were killed on 80% of the understory alpine fir. In the lower Goat River drainage southeast of Prince George, an average of 60% (up to 90%) of the tips were killed on 80% of the understory trees. Intermittant infections affected up to 40% of the branch tips on isolated trees between Valemount and Albreda.

Delphinella sp. tip blight is a chronic problem, particularly in areas which receive higher than average rainfall. Infected trees lose current growth potential proportionate to the severity of infection but quickly regain full vigour when infections drop to endemic levels.

DOUGLAS-FIR PESTS

Douglas-fir beetle, *Dendroctonus pseudotsugae*

Recent attacks by Douglas-fir beetle declined in 1986 to 73 red (1985-attacked) trees in two infestations, near Averil Lake (40 trees) and Eaglet Lake (33 trees). No recent mortality was seen in the long-standing infestations along the Blackwater River. The collapse of populations in this area was due largely to successful B.C. Forest Service trap tree and salvage programs undertaken over the past few years.

The Averil Lake stand in TFL 30 is one of the few remaining mature Douglas-fir stands in the Prince George Region. Over forty 1985-attacked trees were examined during ground checks in June to determine the vigour of beetle populations. Less than 30% of the overwintering broods had survived to mature in the spring, and though many exit holes were seen, only one recently broken top was found to be currently attacked. All 1985-attacked trees had been heavily attacked in 1986 by ambrosia beetles. This stand has been scheduled for logging in an attempt to salvage the high-value wood and to remove any currently infested trees.

'Exploding' Douglas-fir canker

This canker disease has often been found infecting Douglas-fir in certain areas in the southeastern portion of the Region, particularly in stands south of Valemount. In 1986 it was found in a mature stand of Douglas-fir near Averil Lake where the Douglas-fir beetle has been active for at least three years. Approximately 5% of the trees were diseased but infections appeared to occur in distinct groups. No beetle attacks were found in any infected trees.

The disease is caused by an as yet unidentified fungus, though a new specie of *Monilia* was isolated this year from a damage sample. The large open cankers form slowly over time, often originating deep in the heartwood, indicating that trees may become infected at a young age.

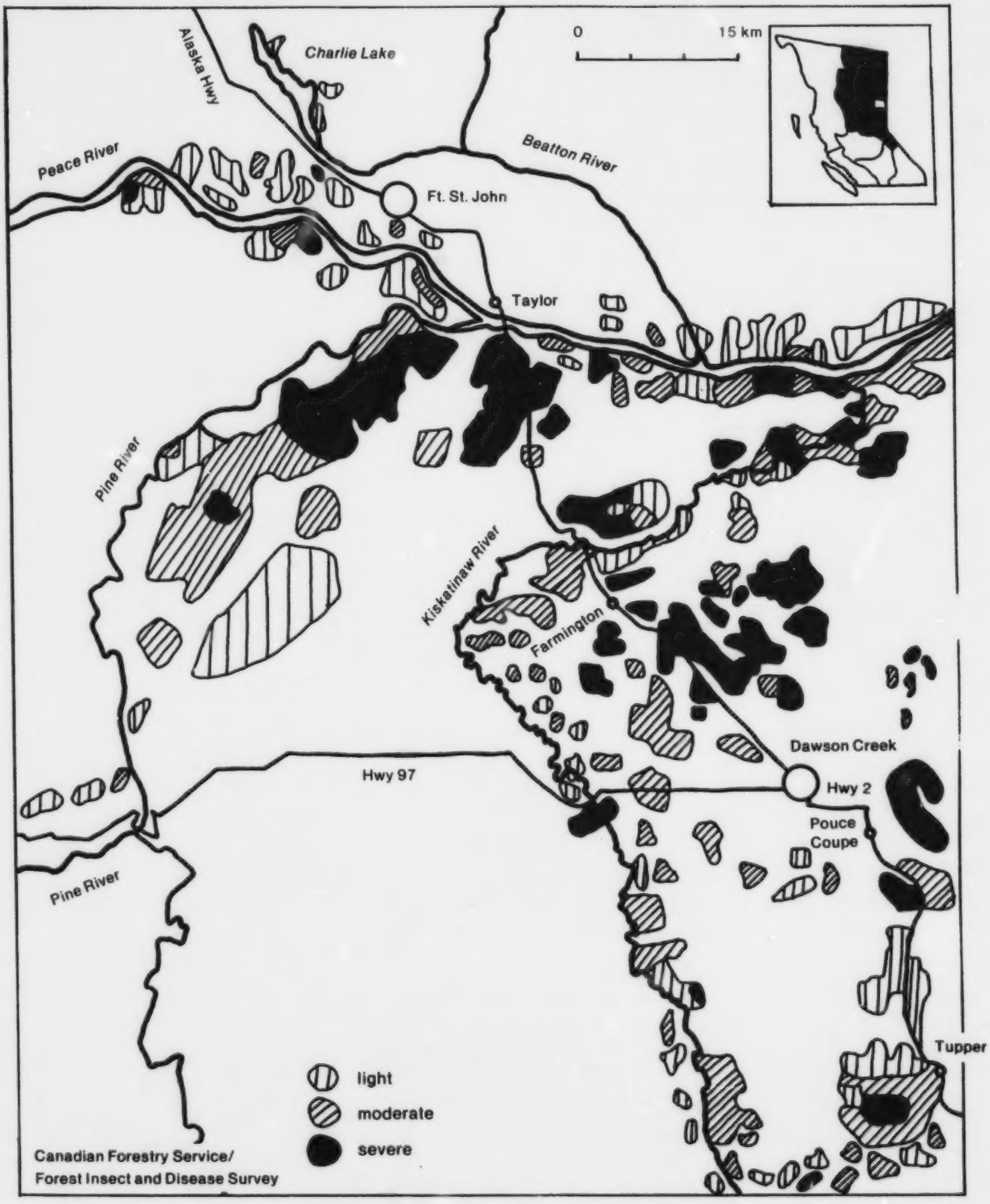
Further studies and collections are planned for 1987, including surveys of Douglas-fir stands west and south of Prince George.

DECIDUOUS TREE PESTS

Forest tent caterpillar, *Malacosoma disstria*

Forest tent caterpillar defoliation of trembling aspen in the Peace River area increased in area to 91 700 ha in 1986 (Map 7) from 56 390 ha in 1985. An infestation in the Salmon Valley which was active for two years prior to collapsing in 1985, recurred in 1986 to cause light and moderate defoliation over 400 ha and 180 ha respectively. High larval populations were also seen on the lower northern and eastern slopes of Tabor Mt. just east of Prince George, but no defoliation was visible from the air.

More than half of the defoliation in the Peace River occurred in four areas where no defoliation was mapped in 1985: on the east side of the Pine River from Fort St. John south almost to Chetwynd, 27 000 ha; east of Tupper,



Map 7. Areas of trembling aspen defoliated by forest tent caterpillar in the Peace River area, Prince George Region, 1986.

8 000 ha; along the Kiskatinaw River between Oetata Creek and Arras, 6 400 ha; and north of Dawson Creek between Farmington and Seven Mile Corner, 5 600 ha. Along the Peace River between the Alberta border and Fort St. John and along the northern end of the Kiskatinaw River, defoliation was mostly light and moderate over 14 100 ha, down from nearly 20 000 ha of severe defoliation in 1985.

Because of an abnormally cool spring, larval development was more than two weeks behind previous years. On June 22, larvae were in 4th and 5th instar, whereas in previous years they would have been emerging from puparia as adults, and mating. A few larvae were seen in mid June hanging in a manner indicative of a viral infection, but observed mortality was less than 1%. Cytoplasmic virus (CPV) was found in a mass collection from Tabor Mt. but unfortunately, larval collections from the Peace River could not be processed. Egg mass surveys were conducted in September at four locations between Tupper and Fort St. John (Table 4).

Table 4. Numbers of new and old egg masses of the forest tent caterpillar and predicted 1987 defoliation, Prince George Region, 1986.

Location	1986 defoliation	Avg. dbh	Avg. no. new egg masses	Avg. no. old egg masses	Predicted[1] 1987 defoliation
5 km S Pouce Coupe	severe	14	11	19	moderate-severe
3 km E Pouce Coupe	severe	7	3.4	10.4	light-moderate
Farmington	severe	11.7	29	46.3	severe
Taylor	moderate	13.8	13.8	25	severe

[1]Based on model developed by Hildahl and Campbell at the Northern Forestry Centre, Edmonton, Alberta.

New egg masses numbered just over half of old egg masses, indicating a decline in populations in 1987, but still sufficient to cause significant defoliation throughout the infested area.

Large aspen tortrix, Choristoneura conflictana

C. conflictana pupae were found in small patches of moderately and severely defoliated trembling aspen near Wonowon, northwest of Fort St. John. Severe defoliation resulted in some top-kill 20 km west of Fort Nelson, but most of the damage appeared to be the result of previous year's feeding. Patches of trembling aspen mortality totalling about 50 ha were located on a mountainside 20 km northeast of Summit Lake, probably a result of repeated severe defoliation.

This is the first reported defoliation by the large aspen tortrix in

northern B.C. since 1982, and may signal the beginning of another damage cycle which has historically lasted for three or four years.

Birch leafminer, Lyonetia saliciella

Following three successive years of significant defoliation by this insect between McBride and Albreda, the only active population in 1986 was found 5 km north of McBride, where 5% of the leaves were mined on 20% of the roadside white birch. No defoliation was mapped this year during aerial surveys.

Populations of this insect often fluctuate greatly from year to year and, following the unusually mild winter of 1986-87, may increase to cause significant white birch defoliation in the coming year.

Gypsy moth, Lymantria dispar

As part of an ongoing interagency monitoring program to prevent the introduction of this potentially serious deciduous defoliator, 39 gypsy moth pheromone traps were placed in provincial parks, rest areas, and private campgrounds throughout the Region. No adult males were caught in the Prince George Region, but catches increased dramatically in the southern portion of the Province. A total of 24 males were caught in 22 traps at 8 locations including the Okanagan, southern Cariboo, Lower Mainland and Vancouver Island. Unless the insect has become established in an area where it was not previously detected, extra traps placed in the summer of 1987 in the same locations should provide effective control.

Ambermarked birch leafminer, Profenusa thomsoni

Larvae of this sawfly were found in 1986 mining the leaves of white birch in a limited but expanded area within the city of Prince George. In 1985 it was found for the first time west of the Rocky Mountains. This year it was found infesting 20% of the leaves of all ornamental white birch in a greenbelt along Patricia Blvd. and nearby Fort George Park. Along Hwy. 16 west to Domano Blvd., 10% of the leaves were infested on 20% of the trees. Along the Hart Hwy. 10% of the trees were lightly infested as far as 8 km north of the Nechako Bridge, and at the Prince George airport, less than 1% of the leaves were affected on 10% of the trees.

The larvae feed within the leaves causing irregular translucent blotches which wrinkle and turn brown. The range of this insect is expected to continue expanding in coming years, though its overall impact on white birch should remain minor.

Diamond willow disease, Cytospora sp. ?

This canker disease of willow species is common and widespread throughout northern latitudes across the country. It was collected in 1986 from stands near Fort Nelson, Fort St. John and Prince George, as well as various sites in the Yukon Territory. Cankered stems are prized by woodworkers for their ornamental shapes, though few are aware that the ornamentation is caused by a fungus disease. Attempts in Canada to isolate the causal agent have so far been unsuccessful though recently in Alaska, a Cytospora sp.

fungus was isolated from a sample.

The disease is thought to infect the willows during periods of stress, particularly drought. Following infection, cankers grow slowly until they girdle and kill the stem.

Further sampling will be done in 1987 in an attempt to isolate the fungus.

A willow canker, Cryptodiaporthe sp.

More than 50% of willow species along the Muskwa River near Fort Nelson were infected with this canker-forming disease. Large dense brooms were formed by rapidly growing water shoots which had sprouted from the base of the cankers. Cankers continue to grow in size until they eventually girdle the stem, killing all growth above that point.

This disease could be considered beneficial from a forestry viewpoint, as willows often compete directly with young conifers.

A bacterium, Pseudomonas syringae

An average of 10% of the leaves on 50% of the sapling-sized trembling aspen in the Pineview area of Prince George were infected with this bacterium, the first time the disease has been recorded on this host. Infected leaves wilt and turn black with symptoms very similar to those caused by Venturia sp. blight.

This disease has never been known to cause serious foliar damage in the forest.

Poplar shoot blight, Venturia macularis

Venturia shoot blight affected trembling aspen in urban and suburban areas of Prince George. In the Pineview area, 30% of young aspen were infected but less than 5% of the foliage was lost. Similar infection levels were found in the College Heights area.

Wet weather in the spring during the spore development period contributed to the increased incidence of the disease in 1986. Infections were light because inoculum sources were limited. A repeat of similar weather conditions in the coming year could result in a significant increase in the occurrence and intensity of the disease.

An elm leafminer, Agromyza sp.

An average of 20% of the leaves, mainly in the lower crowns of 100% of the ornamental elms in the 'Miller Addition' area of the City of Prince George, were infested by this leafminer in 1986. Similar damage was reported on elms in other parts of the City. Mined foliage turned brown in June, withered and was shed prematurely.

Identification of this pest in Prince George constitutes a new distribution record, the first time it has been found west of Edmonton. It is

normally found within its host range in eastern Canada and the United States. The pest was probably brought to Prince George with the trees in the 1960's. Municipal employees report that similar damage has occurred in previous years.

Little is known about this pest because within its eastern range it causes little damage, and has therefore invited little study.

A leafhopper, Oncopsis californica

This insect was found in the upper crowns of 100% of the sapling-sized alder over 2 ha in the Lynx Creek area north of Fort St. James. This sap-feeding insect is not considered a serious forest pest.

Obliquebanded leafroller, Choristoneura rosaceana

Approximately 5% of the foliage on 100% of the trembling aspen was infested by this solitary leafroller just north of the Fraser River bridge beside Hwy. 97. This insect is a significant pest in nurseries and on ornamental trees.

A leaf beetle, Phratora purpurea

Throughout the city of Prince George an average of 5% of the leaves on 90% of the trembling aspen were skeletonized by this insect. This insect is not considered to be of any economic importance.

MULTIPLE HOST PESTS

Black army cutworm, Actebia fennica

Black army cutworm populations increased in 1986 particularly in the Bowron River - Haggen Creek areas where the July 1985 'Pink' fire greatly increased the availability of favored habitat.

Near the junction of the Narrow and Bowron forest roads 10 000 newly planted lodgepole pine were destroyed by budworm feeding over 10 ha on CP 16A, under licence to Northwood Pulp and Timber. Seedling mortality was high because herbaceous plants such as fireweed and false hellebore were not well established on the site so soon following the fire. Over a 5-ha area at Km 10 of the Haggen Road where herbaceous growth was again sparse, 60% of the white spruce seedlings were defoliated, 40% lightly and 20% moderately to severely. Bud damage however, was minimal so little or no seedling mortality is expected. On the north side of Haggen Creek adjacent to Km 15, 10-30% of the herbaceous material was defoliated on two separate sites of about 5 ha each. This area, however, is not scheduled to be planted until the spring of 1987. About 30% of the abundant herbaceous growth was defoliated on a 20-ha south-facing slope near the mouth of the Messinka River. This site was burned in 1984 and planted with lodgepole pine in 1985. No feeding damage was observed on the seedlings.

Larval and pupal collections were made at three locations and reared at PFC to determine levels of parasitism within the population (Table 5).

The first collections at Km 85 Bowron Road and Km 10 Haggen Road were

made in early June where larval development averaged fourth instar. Between then and three weeks later, when the second collections were made at each location, parasitism had almost tripled. Overall, levels of parasitism were moderate and are not expected to greatly influence 1987 populations.

Table 5. Location and % parasitism in mass collections of black army cutworm larvae and pupae, Prince George Region, 1986.

Location	No. insects reared	% parasitized	parasite species
Km 85 Bowron Rd.	32 larvae	10	1 Tachinidae 2 Ichneumonidae
Km 10 Haggen Rd.	165 larvae	17	20 Tachinidae 8 Ichneumonidae
Missinka R.	150 larvae	14	9 Tachinidae 6 Ichneumonidae 23 Braconidae
Km 85 Bowron Rd.	66 pupae	27	9 Tachinidae 11 Ichneumonidae 1 Erigorgus sp.
Km 10 Haggen Rd.	16 larvae/57 pupae	49	1 Tachinidae 21 Ichneumonidae 183 Braconidae

Pheromone-baited sticky traps were placed at 13 locations in late July and collected in mid-September 1986. All of them were located in sites of recent slashburning or wildfires that are scheduled to be planted in 1987. Results of the trapping program are contained in Table 6.

Traps in Haggen Creek were all set perpendicular to the slope (Map 8) and spaced about 150 m apart. No relationship was seen between numbers trapped and relative position on the slope.

The Struble lure with its two constituent attractants consistently trapped more moths than the .4% lure. Regardless of the type of lure used, however, sticky milk carton traps tended to lose their effectiveness as soon as the tanglefoot became glazed with moth wing scales. This normally occurred after 15 to 20 moths had been caught, but sometimes saturation was reached with as few as 10 moths in a trap. This phenomenon severely limited the effectiveness of sticky traps to predict anything beyond low populations where fewer than 10 moths were caught.

Table 6. Location and numbers of adult male black army cutworm caught in pheromone-baited sticky traps, Prince George Region, 1986.

Location	No. of traps[1] .4%	Struble[1]	Avg. no. adults trapped .4%	Struble
Km 15 Haggen Cr. site A	5		9.0	
B	5		10.4	
D	5		15.2	
E	5	5[2]	11.0	12.4
F	5	4[2]	10.8	11.8
Km 108 Narrow Rd.	5	5	13.6	17
Km 109 Narrow Rd.	5		17.6	
Km 97 Narrow Rd.	5		3.6	
Summit L.	5		4.0	
Angusmac Cr.	5		11.8	
Caine Cr. #1	5		9.6	
Caine Cr. #2	4[2]		7.0	
North Fraser	5	5	4.2	24
Bill's Cr.	5	5	5.6	10.2

[1] .4% z-7-dodecenyl
Struble z-7-12:AC
z-11-14:AC

[2] one trap not found

MAP 8

In 1987 a new trapping medium will be employed operationally for the first time against the cutworm. The non-sticky 'Multipher' traps are made of hard plastic, are weatherproof, and can store hundreds of moths without saturating. In addition, moths attracted into the container are killed chemically by a 'Vapona' strip and remain intact, greatly simplifying subsequent handling for counting, shipping and identification. Increased numbers of moths in the traps will increase their sensitivity to fluctuations in population and, subsequently, their usefulness as a predictive tool.

Trap catches in 1986 were probably influenced by slash burning which was ongoing in the Bowron River and Haggen Creek areas during the moth flight period. Many or most of the female moths were likely drawn to these newly burned sites rather than laying their eggs in year-old burns. Close attention will be paid to these new burns in the spring of 1987, particularly those scheduled for planting.

Barring an unusually cold spring or the sudden appearance of a viral infection throughout the population, the black army cutworm could reach epidemic levels in the Bowron drainage in 1987. Silviculturists will need to be vigilant for signs of early feeding in areas scheduled for planting.

Clearwing moths, Sesiidae

As part of a special pheromone trapping program to determine the distribution of clearwing moths in B.C., traps were placed in various stand types around the city of Prince George between June and September. A total of 215 male moths of three species were trapped, including 185 Synanthedon culiciformis, 27 S. novaroensis, and 3 S. proxima.

The only clearwing moth of any economic importance in B.C. forests is the sequoia pitch moth, Synanthedon sequoiae, the larvae of which bore into the cambium of ponderosa and lodgepole pine, often causing serious damage to young trees. Damage caused by this insect is rare in the Prince George Region.

ENVIRONMENTAL DAMAGE

Blowdown

A total of 260 ha of recent blowdown was mapped by aerial survey in the southern half of the Region, slightly more than in 1985. Nearly 75% of this area was in four patches of white spruce and alpine fir near the adjacent headwaters of Everett and Dome creeks. An additional 10 ha was seen near the head of Kenneth Creek in the Bowron Valley. In Hellroaring Creek, a tributary of the Morkill River, two patches of white spruce-alpine fir blowdown totalled 27 ha. In the Mackenzie area, 30 ha of white spruce and alpine fir near the headwaters of the Misinchinka River were blown over, as well as 25 ha of lodgepole pine near the south end of Williston Lake.

Where possible, spruce blowdown will be monitored in 1987 for a potential buildup of spruce beetle populations.

Drought

Trembling aspen and white birch at widespread locations throughout the southern half of the Region showed symptoms of moisture stress resulting from the prolonged drought during the summer of 1985. Both species exhibited thin crowns in 1986 with foliage reduced in size and amount. The most severe symptoms were seen along Hwy. 16E from Prince George to Purden Lake, and along Hwy. 16W to Vanderhoof, where virtually all trees of both species were crown-thinned. Approximately 20% of the larger trees (mostly white birch) had suffered top dieback. Severe frosts in early winter 1985 may have combined with the stress caused by drought to kill these tops.

Drought symptoms were also evident in some young conifer stands. On the south shore of Nations Bay on Williston Lake, 10% of the 1985 and older needles on 75% of the young lodgepole pine were discolored from drought stress and sunscald. Similar damage was seen on a 20-ha lodgepole pine plantation near Ogston Lake and on white spruce seedlings in a one-year-old plantation at Km 63 of the Bowron Road. At Km 2 of the Shesta Lake Road 15% of the buds in the lower crowns of 50% of the young lodgepole pine failed to flush due to moisture stress.

Nutrient deficiency

A nutrient deficiency caused discoloration of 10% of the needles on 50% of the lodgepole pine roadside regeneration between Vanderhoof and Dog Creek. Near Red Rock, 30% of the two-year-old and older needles on young roadside lodgepole pine were discolored due to suspected nitrogen deficiency.

Frost damage

In a 20-year-old naturally regenerated white spruce stand 2 km north of Anzac Camp, 5% of the buds of 50% of the trees were killed by frost. In a young stand of mixed species southeast of Prince George, near Hungary Creek, 5% of the branch tips on the Douglas-fir component of the stand were frost-killed.

CONE AND SEED PESTS

In 1986 less than 5% of white spruce trees, the main source of seed for the Region, supported a crop. As normally occurs when few cones are produced, a high proportion were infested. Cones were harvested from six areas in early August and the results of cone analyses from five of them are contained in Table 7. The sixth collection, white spruce cones from Fraser Mt. near Fort Fraser, is awaiting seed analysis.

Table 7. Locations of cone collections and pest problems encountered, Prince George Region, 1986.

Location	Host[1]	% infested	Pest
Km 90 Bowron Coal Road	wS	50	Hylemya anthracinum
		20	Cydia strobilella
		10	Dasineura rachiphaga
McLeod Lake	wS	55	Hylemya anthracinum
		15	Cydia strobilella
		5	Dioryctria abietivorella
Km 75 Bowron Road	wS	35	Hylemya anthracinum
		10	Cydia strobilella
Sinkut L/O Road	wS	50	Hylemya anthracinum
		33	Cydia strobilella
		8	Dasineura rachiphaga
		2	Dasineura canadensis
Fraser Mt. Road	D	10	Dioryctria abietivorella

[1] wS - white spruce, D - Douglas-fir

PESTS OF YOUNG STANDS

Six young stand examinations were made in 1986. Of these, four were in stands where white spruce formed a major component (Table 8). Sapling-sized white spruce stands are uncommon in the Prince George Region, but many plantations have recently been established and there is a need for more baseline information on pests of young spruce. The most significant pest this year was the spruce gall aphid, Adelges cooleyi, which was commonly found infesting branch tips where the alternate host, Douglas-fir, was growing in close proximity. Repeated severe gall formation can significantly retard the growth of young trees. The roots of young spruce trees at each location were examined for evidence of infection by Inonotus (Polyporus) tomentosus root rot, but none was found. Two lodgepole pine stands were also examined. The most significant damage in these stands was the loss of buds and needles from drought stress.

Table 8. Pests of Young Stands

Location	Species Composition (%)	Age (yr)	Treatment	No. plots	Avg. no. trees per plot	No. trees per ha	Pest	Description
Rm 2 Shasta Lk. Rd.	lP[1] 95	15	spaced	10	6.2	1857	Cronartium coleosporioides	5% trees with branch cankers 2% trees with stem cankers
							unid. needle cast	older lower crown needles on 93% trees
							Scirrhia (Dothistroma) pini	5% needles on 25% trees
							drought stress	avg. 15% lower crown buds on 49% trees
							Endocronartium harknessii	branch galls on 2% trees stem galls on 3% trees
							deer	17% trees browsed
							mechanical injury from spacing	5% trees
							poorly formed trees	3%
	wS 5						Adelges cooleyi	100% trees
Ogston L.	lP 98	13	spaced	10	6.6	1320	drought stress	5% needles killed on 65% trees
							E. harknessii	branch galls 5% trees
							poorly formed trees	5%
							deer	5% trees browsed
							Hylobius warreni	2% trees killed

Location	Species Composition (%)	Age (yr)	Treatment	No. plots	Avg. no. trees per plot	No. trees per ha	Pest	Description
2 km N of Anzac Camp	wS 100	20	natural	no plots			A. cooleyi	70% trees
							frost damage	5% buds on 50% trees
							Pissodes strobi	15% trees (12% old, 3% new)
Hwy. 16 E Hungary Cr.	lP 40	40	spaced	no plots				unid. needle cast 10% 2-yr-old a needles on 80% trees
	wS 40						A. cooleyi	10% branch tips on 100% trees
							P. strobi	5% leaders currently infested (20% 1985 attacks)
	D 10						frost damage	5% branch tips
	alF 10							
Km 30 McGregor Rd.	wS 85	25	natural	no plots			A. cooleyi	avg. 40% (up to 80%) branch tips on 100% trees
							Choristoneura biennis (on alF and wS)	feeding evidence on 5% branch tips
Burden Lake	wS 90	25	natural	no plots			A. cooleyi	avg. 30% (up to 70%) branch tips on 100% trees
	lP 9							
	D 1							

[1] lP - lodgepole pine, wS - white spruce, D - Douglas-fir, alF - alpine fir